

Electromagnetic Information Delivery as a New Perspective in Medicine

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Abstract— Since the time of Hippocrates it is very well known that it is possible to transfer biochemical information for the treatment of human diseases by using molecules as active principle.

This strategy has been the most efficient one until the time of Becker and Fröhlich when we become aware that it was also possible transfer effective information to biological target by the use of electromagnetic field in the ELF range. Later on Benveniste suggested that for every chemical molecule there is only and only one electromagnetic image a kind of electromagnetic signature. Benveniste and coworkers demonstrated that picking up the physical signals of a chemical compound and transferring it to an aqueous system by mean of an electronic device this procedure was mimicking the same effect of the chemical source molecule. The transfer of the physical activity is probably mediated and can be amplified by water biophysical re-patterning. Electromagnetic Information Transfer of Specific Molecular Signals according to previous report and ours was performed in order to understand the possible role of water in mediating the electro-magnetic information transfer of biological active molecules such as retinoic acid (RA). The electromagnetic information signals from the retinoic acid solution (RA-EMIT) was captured and transferred to the target by a commercially available oscillator (Vega Select 719). The retinoic acid signals was transferred to a cell culture medium (RPMI). Neuroblastoma Cell Line (LAN-5) was seeded and grown up for four days in presence of Retinoic Acid signal and/or chemical molecule. The experimental findings demonstrated that the RA signal shows the tendency to behave as a differentiating agent such as the original molecule.

1. INTRODUCTION

Aqueous system is universally assumed as the basis for any living process. Someone suggested that water could be considered as the forgotten matrix of life [1]. As a matter of fact Tales of Miletus was the first philosopher assuming water as the primary essence of nature. Nevertheless only recently the role of water has been reconsidered as more than a simple solvent and has been established that aqueous system could play an active role in the architecture and function of cell and tissues [2–5]. Moreover an additional role of aqueous system has been outlined in their ability of processing, storing and retrieving electro-magnetic information [6, 7]. Our hypotheses is that an aqueous system, such one of those enfolded in livings, could play an additional role in modulating biological functions providing basis for processing, storing and retrieving information mediated by electro-magnetic signals mimicking the effect of a specific drug or driving a specific endogenous function. Liquid water shows many anomalies in its thermodynamics properties such as compressibility, density variation and many others. Some of these features are more evident at low temperatures but they are still present at room temperature where living systems exert their biological activities. At ambient conditions our traditional view of water is an homogeneous distribution of tetrahedral structure hydrogen bonded. In spite of this very simple description a more complex picture arise from recent report identifying inhomogeneous structures at ambient condition [8-10] that could fit the concept of coherent domains as previously described by the Italian physicist Giuliano Preparata applying the Quantum Electrodynamics Theory (QED) to the understanding

of water and of biological systems behavior [11]. According to QED liquid water can be viewed as an equilibrium between two components: coherent and incoherent ones. The coherent component is contained within spherical, so called “Coherence Domain” (CD), where all water molecules synchronously oscillate with the same phase. Coherence Domains are surrounded by the incoherent component where water molecules oscillate in random phases regardless each other. In this framework an aqueous system such one enfolded in livings could play an additional role in modulating biological functions by generating dissipative structure providing basis for processing, storing and

retrieving information mediated by electro-magnetic signals [6, 7, 11, 12]. Any electro-magnetic signals, both endogenous and exogenous, when became resonant with some of the coherent domains of water can induce a dipole moments re-patterning therefore inducing these structure to oscillate coherently each other generating a new phase correlation described as a super-coherent [13]. This procedure could allows to an external pattern of electro-magnetic signals to be stored, translated and transferred by the water structure of the aqueous systems toward the biological target selectively modulating their activity. Some experimental evidence of the process defined as electro-magnetic information delivery mediated through aqueous system has accumulated in the last two decades (14–22). In order to test the hypotheses that aqueous system could be able to store and transfer specific information to a biological target we design the following “in vitro” experimental procedure.

2. MATERIAL AND METHODS

2.1. Cell Cultures

LAN-5 human neuroblastoma cells were grown in RPMI (Gibco Laboratories, Scotland) supplemented with 10% Fetal Calf Serum (Gibco Laboratories, Scotland) and antibiotics (110 IU/ml of penicillin and 0.1 mg/ml of streptomycin) at $37 \pm 0.3^\circ\text{C}$, and 5% CO_2 as carbon source and sub-cultured twice a week at a 1 : 5 ratio. In our paper the cells were cultured and treated for 4 days in 3 different conditions: they were grown in absence (control) and in presence of electro-magnetic signal of the Retinoic Acid (RA emmitas) and also treated with chemical Retinoic Acid (RA, $5 \mu\text{M}$ Sigma) which was used as positive control.

2.2. Transmission Apparatus

For the transmission experiments to cell’s medium, the input coil was operated at room temperature and was coupled via a homemade amplifier (Gain 0.25 dB from 1 to 100 Hz maximum output voltage 20 V p-p, maximum output current 1 A, Max Power 20 W_{rms}) to a commercial available wave generator (VEGA Select 719). Into the output (target) coil was placed the cell’s culture medium. The target coil was made of 85 turns of 2 mm copper wire, 17 cm long and 9.5 cm width and fed at 100 mV from the wave generator. The source tube containing $5 \mu\text{M}$ RA was placed

inside the input coil. The signal from the Retinoic Acid (RA) solution in the coil was fed into the electronic amplifier, then from the electronic amplifier the signal was transferred to the wave generator. In the wave generator the electronic signal corresponding to RA was superimposed over a 7 Hz sinusoidal frequency carrier modulated at 3 kHz as previously reported [19–22]. From the wave generator then, the signal was delivered to the culture medium. During the entire experimental procedure all the electrical parameters remained constant.

2.3. Cell Medium Conditioning

Retinoic Acid, a well known chemical differentiating agent, were placed at room temperature in the input coil connected to an oscillator (Vega Select 719), while culture medium for LAN-5 neuroblastoma human cells was placed into the output coil and exposed to RA electro-magnetic signals for one hour. At the end of the exposure time the oscillator was switched off and LAN-5 neuroblastoma cells seeded on petri dish, cultured using this previously conditioned medium and placed, as usual, into a cell incubator under controlled growing conditions.

2.4. Cell Growth and Mortality Analysis

For each experimental condition, cells were grown for 4 days. At day 1, 2, 3 and 4, cells were harvested with 0.1% trypsin-EDTA (Sigma), washed twice with PBS and the total number of nucleated and viable cells was counted by Trypan Blue dye (0.4%) (Sigma) exclusion assay using a Bürker hemocytometer chamber.

2.5. Cell Metabolic Activity Analysis

The quantification of LAN-5 metabolic activity, as an index of cellular proliferation, was performed by a colorimetric assay based on oxidation of tetrazolium salts (Cell Proliferation Reagent water soluble tetrazolium salt (WST)-1; Roche Diagnostics Basel, Switzerland). The LAN-5 cells were seeded on in 96-well plates and grown in the three different conditions (Ctr, RA and RA emittas) up to 4 days. Water soluble Tetrazolium salt (WST-1) reagent diluted to 1 : 10 was added in the medium at 1, 2, 3 and 4 days and then incubated for 2 h in humidified atmosphere (37°C , 5% CO_2). The quantification of LAN-5 metabolic activity was performed by absorbance measurement at 450 nm with a scanning multiwell spectrophotometer (Biotrack II; Amersham Biosciences).

3. ANALYSIS OF NEURITE OUTGROWTH

The LAN-5 cells were seeded on Petri dishes and grown for 4 days in the three different conditions. At the end of these treatments the cells were, washed in PBS, fixed in paraformaldehyde 4% in PBS for 15 min, and tested by phase contrast microscopy to observe cell morphology and to visualize the presence of neuritic structures that were counted to obtain the percentage of cells having neurite outgrowth. Phase contrast analysis were performed using an inverted microscope (Olympus IX51, RT Slider SPOT — Diagnostic instruments) equipped with a 20X, 40X and 60X objective and with a cooled CCD camera (Spot RT Slider, Diagnostic Instruments).

4. RESULTS AND DISCUSSION

In this study, we demonstrated that the electro-magnetic signals of the Retinoic Acid molecule can be recorded and stored by the aqueous system of the cell culture medium. Neuroblastoma cell line (LAN-5) was grown up to 4 days in standard medium (Control = CTR) or in the presence of

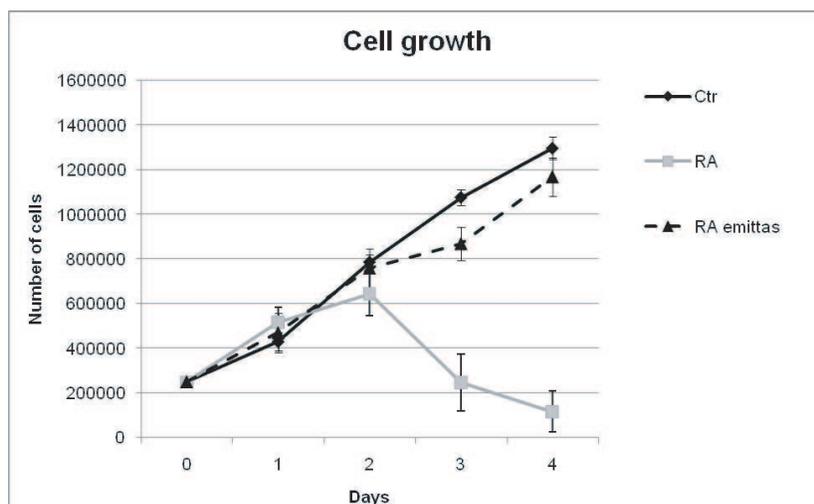


Figure 1: Cell growth analysis: $*p < 0.05$.

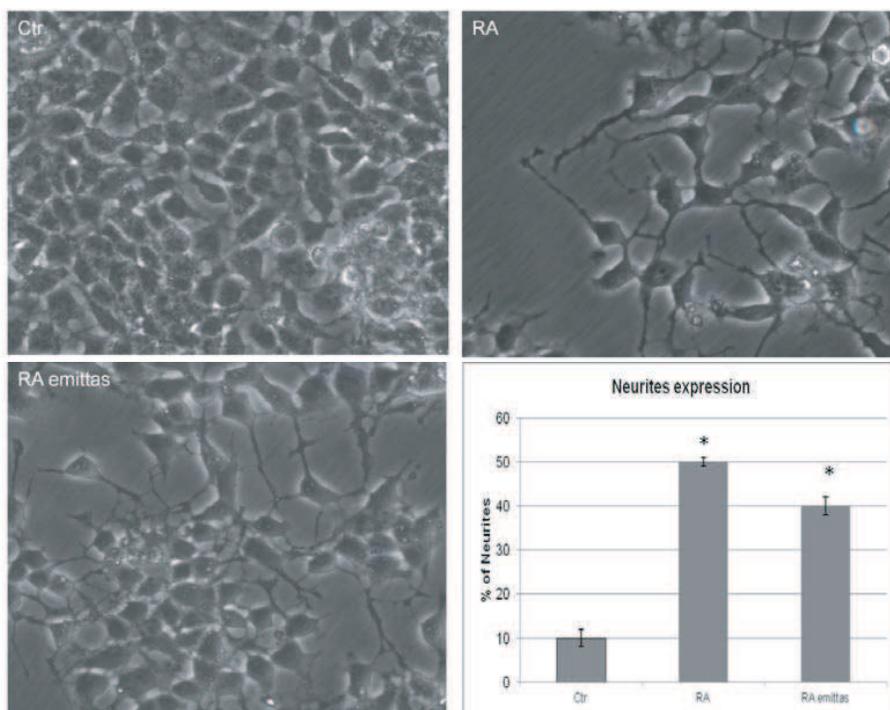


Figure 2: Analysis of neurite outgrowth expression: $*p < 0.05$.

Retinoic Acid signal (RA-emittas). The treated cell with chemical Retinoic Acid molecule was also used as positive control (RA). Cell growth and mortality, analysed by direct cell count using Trypan Blue dye exclusion assay, showed that treatment with chemical Retinoic Acid dramatically decreased LAN-5 cell growth and increased cell mortality compared to control one (Fig. 1). Interestingly, cells grown in presence of the electromagnetic signal of the RA (RA emittas), showed a statistically significant decrease of cell growth, similarly to RA treatment, but no changes in cellular mortality as compared to control cells (Fig. 1). These findings demonstrate that the electromagnetic information system is able to induce the decrease of cell growth without affecting cell viability. WST-1 assay confirmed these results, also highlighting a metabolic activity reduction in the LAN-5 cells grown in the presence of electro-magnetic signals of RA (RA emittas), compared to control ones (Fig. 3). The neurite outgrowth was also studied by phase contrast microscopy analysis and the number of neuritic structures developed by LAN-5 cells cultured in the three different conditions (Ctr, RA and RA emittas) for 4 days, was counted (Fig. 2). The control cells grew as a monolayer of confluent cells, with very few neuritic-like structures. Instead, the LAN-5 cells, treated with electromagnetic signal of RA (RA emittas), increased the number of neuritic structures, that are typically expressed in differentiated neuronal cells. The same structures, having a well organized neuronal network, were observed in our positive control, the LAN-5 cells treated with chemical Retinoic Acid, as reported in Fig. 4. These results provide further evidence that aqueous system can be tuned in a resonant manner by an appropriate electro-magnetic information delivery procedure. These data suggest a possible future application of electro-magnetic information delivery protocols for the synergic treatment of a wide range of human diseases by means of specific informative frequency patterns, delivered through and to aqueous systems, providing an important integrative tool in clinical practice.

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